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Exercise therapy for trismus in head and neck cancer

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The aim of this study was to analyze retrospectively effects of exercise therapy on trismus related to head and neck cancer or as a consequence of its treatment, and to compare these effects with trismus not related to head and neck cancer. Medical records of patients referred to the department of physical therapy with the diagnosis trismus were retrieved and analyzed. Data of 27 patients with trismus related to head and neck cancer and data of eight patients with trismus not related to cancer were found. The number and type of exercises were registered from the records, as was the extent of mouth opening before and after exercise therapy. The median (IQR) number of exercise treatments was 4 (3–9.3). Exercises included active range of motion exercises, hold relax techniques, manual stretching and joint distraction. The increase in mouth opening was significantly ($p \leq 0.05$) less in the group of patients with trismus related to head and neck cancer (mean increase: 5.5, sd: 6.0) as compared to the increase in mouth opening in the group with trismus not related to cancer (mean increase: 17.1, sd: 9.0). The mean number of treatments given to the group with trismus related to head and neck cancer (7.7) and the group with trismus not related to head and neck cancer (6.1) did not differ significantly. It is concluded that trismus related to head and neck cancer is difficult to treat with exercise therapy.

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Introduction

Trismus, severely restricted mouth opening, may occur as a result of intra capsular pathology of the temporomandibular joint or as a result of extra capsular pathology. Extra capsular causes of trismus are for example peritonsillar abscess,¹ dental infections,^{2,3} noma⁴ trauma to mouth closing muscles,⁵ mandibular nerve blocks (post injection trismus),^{6–9} tetanus,¹⁰ cancer^{11–13} and submucous fibrosis due to chewing betel nut.^{14,15} In patients with head and neck cancer the tumour may grow into or near mouth closing muscles, inducing a reflex contraction. This reflex contraction prevents the stretching of mouth closing muscles, which results in trismus. Trismus may also occur as morbidity from cancer therapy. Surgery may induce scar tissue which reduces mouth opening due to scar contraction in mouth closing muscles. Additionally, radiotherapy may induce fibrosis in mouth closing muscles as a late radiation effect.^{11,16,17}

Several different criteria sets for trismus exist with reference to head and neck cancer, but there is not one generally accepted set of criteria.¹⁸ In a recent cross-sectional study, 35 mm or less was proposed as a criterion for trismus, based on the extent of the restrictions perceived in mouth opening and mandibular function by the patients.¹⁹ If possible of trismus related to head and neck cancer should be prevented because once trismus has occurred it is very difficult to treat. However, no evidence exists on how trismus due to cancer or its treatment should be prevented and limited evidence exists as to how trismus can be treated most effectively.¹⁸ Exercises are frequently proposed to prevent or treat trismus, including active range of motion exercises combined with passive range of motion exercises. Usually some tools are used as incentives to enhance exercise compliance or to increase therapeutic effectiveness. These tools include rubber plugs, wooden tongue blades, TheraBite[®] exercisers and dynamic bite openers.

Only four studies exist in which the effects of interventions on trismus are investigated. In a randomised clinical trial a TheraBite[®] apparatus increased mouth opening significantly more than exercises with wooden tongue blades or manual stretching.²⁰ In a recent cohort study an evaluation was made of mouth opening in patients treated for an oropharyngeal squamous cell carcinoma, when using a TheraBite[®] apparatus. Mouth opening increased significantly in the course of treatment.²¹ To the best of our knowledge, no other studies than the two mentioned above, have analyzed the effects of exercise therapy as a treatment for trismus related to head and neck cancer.¹⁸ In two cohort studies other interventions for the treatment of trismus related to head and neck cancer were evaluated; microcurrent electrotherapy and pentoxifylline.^{22,23}

The aim of the present study is to evaluate retrospectively changes in mouth opening in patients referred to the Department of Physical Therapy of the University Medical Center Groningen for treatment of trismus.

Materials and methods

From the medical records of the department of oral and maxillofacial surgery of the University Medical Center Groningen, The Netherlands, files were retrieved of patients who

had been referred to the department of physical therapy for treatment of trismus between 1997 and 2005. Excluded were patients with a restricted mouth opening due to internal derangement of the temporomandibular joint or other intra capsular causes of trismus. Physical therapy files of the patients identified were also retrieved. The following data were collected from the files: age at the time of referral to the department of physical therapy, gender, whether the trismus was related to head and neck cancer or not, interval between cancer treatment and start of the physical therapy, types of interventions of physical therapy, number of treatments at the department of physical therapy, and mouth opening before and after physical therapy.

Data analysis

All data were entered in a database and analysed using SPSS version 12. Comparisons within the groups were performed using paired sample *t*-test; comparison between the groups were performed using independent sample *t*-test. If data were skewed Mann–Whitney-*U* tests were used to analyse the difference between the groups. Effect sizes ($\text{mean}_{\text{change}}/\text{sd}_{\text{pre-treatment}}$) were calculated for comparison of the results with results of previous studies. Using χ^2 analysis differences were analysed in percentages of patients in both groups with a mouth opening of 35 mm or less after completion of physical therapy.

Results

In total, 37 files were identified of which 29 were of patients with trismus related to head and neck cancer and eight were of patients with trismus not related to cancer. Two patients with trismus related to head and neck cancer were seen at the department of physical therapy only once and were subsequently referred to a physical therapist in their own town because of travelling distances. No data about mouth opening after treatment are available for these patients. Patient characteristics, diagnosis and tumour localisation have been summarised in Table 1. Dental status did not change during physical therapy treatment. Mouth opening before treatment, change in mouth opening and number of physical therapy treatments have been presented in Table 2. Effect sizes ($\text{mean}_{\text{change}}/\text{sd}_{\text{pre-treatment}}$) are also presented in Table 2. Mouth opening increased significantly in both groups. The increase in mouth opening was significantly higher in patients treated for trismus not related to head and neck cancer. In general, physical therapy treatments were stopped when mouth opening did not improve any further or when a functionally acceptable mouth opening for the patient was reached. The increase in mouth opening in patients with trismus related to head and neck cancer did not significantly differ between patients with tumour and without tumour recurrence. The number of physical therapy treatments was significantly higher for patients with tumour recurrence than for patients without tumour recurrence (Table 3).

On some patients with insufficient improvement of mouth opening and no evidence of tumour recurrence, additional surgical procedures were performed to improve mouth opening. Two patients with trismus not related to

Table 1 Descriptive statistics of the population

Patient and treatment characteristics	
Age, mean (sd)	44.7 (15.9)
Gender	% (n)
– Male	43% (16)
– Female	57% (21)
Trismus not related to cancer	22% (8)
– Post injection	63% (5)
– After release of pharyngeal abscess	13% (1)
– Removal of distractor	13% (1)
– Closing of palatal defect	13% (1)
Interval between end of medical treatment and of start physical therapy in days. Median (IQR)	29.5 (22.5–44.8)
Trismus related to head and neck cancer	78% (29)
Localisation of tumour	
–Oropharynx	28% (8)
–Parotid	14% (4)
–Maxilla	14% (4)
–Trigonum retromolare	14% (4)
–Floor of mouth	10% (3)
–Gingiva	7% (2)
–Other localisation ^a	14% (4)
Recurrence of tumour	17% (6)
Radiated	90% (26)
–Physical therapy during radiation therapy	35% (10)
–Interval between end of radiation and start of physical therapy in days. Median (IQR)	255 (52–355.8)
–Interval between end of surgical treatment and start of physical therapy in days. Median (IQR)	140 (31.5–296)
Treatment provided by physical therapists ^b	
–Active range of motion	100% (37)
–Hold relax	58% (22)
–Manual stretching	57% (21)
–Joint distraction	21% (8)
Therapeutic tools	
–Rubber plugs	62% (23)
–Tong blades	38% (14)
–Dynamic bite opener	5% (2)
–TheraBite® apparatus	5% (2)
Number of treatments. Median (IQR)	4 (3–9.3)

^a Due to rounding off the total percentage exceeds 100%.

^b All patients received more than one type of exercise treatment.

Table 2 Mouth opening, increase in mouth opening, and number of physical therapy treatments in patients with trismus related to head and neck cancer and patients with trismus not related to cancer

	Trismus related to head and neck cancer (n = 27)	Trismus not related to cancer (n = 8)	Difference between groups (95% CI)
Mouth opening: mean (sd)	19.3 (7.4)	17.6 (6.8)	1.6 (–4.3 to 7.6)
Increase in mouth opening: mean (sd)	5.5 (6.0)	17.1 (9.0)	11.6 (6.1 to 17.2)
95% CI of the increase	3.1 to 7.9	9.6 to 24.7	
Effect size of increase in mouth opening	0.74	2.51	
Number of physical therapy treatments: mean (sd)	7.7 (9.0)	6.1 (3.9)	ns

95% CI: 95% confidence intervals, Effect size = $\text{mean}_{\text{change}}/\text{sd}_{\text{pre-treatment}}$, ns: difference in number of physical therapy treatments not significant (results of Mann–Whitney-*U* test).

Table 3 Within the patients with trismus related to head and neck cancer, increase in mouth opening and number of physical therapy treatments of patients with tumour recurrence and patients without tumour recurrence

	Recurrence	No recurrence	Difference between groups (95% CI)
Increase in mouth opening: mean (sd)	2.8 (7.4)	5.8 (5.2)	2.9 (−1.9 to 7.7)
Effect size	0.46	0.72	
Number of physical therapy treatments: mean (sd)	14.9(13.3)	3.9 (3.2)	*

* Difference in number of physical therapy treatments is significant (results of Mann–Whitney-*U* test).

cancer were treated by the oral and maxillofacial surgeon by means of a coronoidectomy and release of the tendon of the temporal muscle followed by physical therapy.²⁴ In the one patient mouth opening remained 28 mm after surgery and in the other patient mouth opening increased from 23 mm to 37 mm. One patient with a mouth opening decreasing from 19 to 10 mm related to a low grade adenocarcinoma also underwent a coronoidectomy, followed by physical therapy, but mouth opening remained severely restricted (12 mm). Another patient had trismus related to a radiation induced osteosarcoma of the maxilla. Radiation treatment had been performed 21 years previously because of a rhabdomyosarcoma of the palate. The osteosarcoma of the maxilla was treated by means of chemotherapy, followed by surgical resection. Afterwards the patient was referred for physical therapy for trismus. Mouth opening remained severely restricted (14 mm). Two years later the patient had reconstructive surgery because of severe facial asymmetry and scar tissue. Trismus was surgically treated in the process. Scar tissue was removed, a coronoidectomy was performed, and the temporalis and the medial pterygoid muscles were released. Afterwards the patient was referred to the department of physical therapy. Exercise therapy was performed until mouth opening stabilised at 30 mm about 1 month after surgery.

After completion of physical therapy, 69% of the patients still had a mouth opening of 35 mm or less, 78% in the group with oncology related trismus and 38% in the group with trismus not related to oncology ($p = 0.031$).

Discussion

Mouth opening increased significantly after physical therapy. The increase in mouth opening was significantly higher for patients with trismus not related to cancer (17.1 mm) as compared to the increase in patients with trismus related to head and neck cancer (5.5 mm), while the number of treatments did not differ significantly between the groups.

Only two studies, mentioned in the introduction, have been published that evaluated exercise therapy in oncology related trismus. In a randomised clinical trial patients were included who had undergone radiotherapy in the 5 years preceding the trial. A TheraBite® apparatus increased mouth opening (13.6 mm) significantly more than exercises with wooden tongue blades (6.0) or manual stretching of mouth opening (5.4 mm). However, no follow-up data have been given and the sample size of the trial was relatively small ($n = 21$).²⁰ In the current study, the increase in mouth opening of patients with trismus related to head and neck cancer was similar to that by means of wooden tongue blades and manual stretching in the randomised clinical trial.²⁰ In the current study no comparison was made be-

tween these two types of exercises (tongue blades or manual stretching) because the physical therapist applied those techniques which he/she judged to be most appropriate. In another study, 11 patients who were treated for an oropharyngeal squamous cell carcinoma were enrolled immediately after surgery in a pilot study to analyse effectiveness of a TheraBite® apparatus.²¹ The mean increase in mouth opening after follow-up (12–48 weeks) was 9.7 mm. It is not clear, however, whether the patients included would actually have developed restricted mouth opening because only one patient had a mouth opening less than 25 mm on entering the study. Furthermore, only seven complete sets of data were available for analysis.²¹

The increase in mouth opening of patients with trismus not related to cancer was substantial in the current study. Comparison of this increase with data from previous research on this topic is difficult, because other studies did not evaluate mouth opening after ending treatment.^{6,7,9} The restricted mouth opening in previous studies was mostly related to an inferior alveolar nerve block.^{6,7,9} The proposed therapies for post injection trismus in literature are “watchful waiting”, applying exercise therapy and if not successful after some time, forcing of mouth opening under general anesthesia.^{6,7}

In two patients with trismus not related to head and neck cancer mouth opening did not increase sufficiently and they were therefore treated with surgery. In the one patient mouth opening remained restricted. In the other patient mouth opening increased from 23 to 37 mm. In two other patients with trismus related to head and neck cancer, physical therapy could not improve mouth opening. Subsequent extensive surgical procedures helped one patient but not the other.

The effect size of the group with trismus related to head and neck cancer (0.74) was considerably lower than the effect size of the group with trismus not related to cancer (2.51). Compared to the results of previous studies the effect size of the current study is less than calculated from the results of the studies of Buchbinder et al. (2.6)²⁰ and Cohen et al. (1.8).²¹ This effect size comparison shows that the TheraBite® apparatus is more effective in increasing mouth opening, related to the variation in mouth opening prior to therapy. Effect sizes of tongue blade therapy and of forced opening were 1.5, and 1.1²⁰, respectively in that trial. With the outcome of the current study the department of physical therapy will have to reconsider the currently used exercise programs for trismus related to head and neck oncology.

Effects sizes calculated from studies that evaluate effects on mouth opening of exercises and manipulation in case of anterior disc luxation without reduction are generally higher 0.9,²⁵ 1.2,^{26,27} 1.7²⁸ and 3.4²⁹ than the effect

size in trismus related to head and neck cancer. These findings suggest that trismus related to head and neck cancer is more difficult to treat than trismus related to other causes.

Basically, the current study is a historic cohort study without follow-up, based upon medical and physical therapy records. It is not clear whether the increase in mouth opening was sustained after therapy was finished. Moreover, it is not clear whether the increase in mouth opening can be attributed to the effects of exercises or to the phenomenon of regression to the mean, since many patients seek help only when complaints are at their peak. Furthermore, the simple fact that a health care provider (physical therapist) is actually doing something (exercising) about the restricted mouth opening may induce an increase in mouth opening: the so called a-specific effect of an intervention. This phenomenon is less likely to occur in trismus related to head and neck cancer because cancer surgery is often more extensive than removal of a third molar or drainage of an abscess, and thus results in more extensive scar formation. In addition radiotherapy induces direct radiation effects such as including mucositis, but also late effects such as fibrosis. Once fibrosis has occurred it is difficult to stretch. These arguments are supported by the findings that after physical therapy about twice as many patients with trismus related to head and neck cancer did not reach normal mouth opening (>35 mm) as compared to patients with trismus not related to cancer.

The increase in mouth opening did not differ between patients with and without tumour recurrence, although the mean increase was lower for the group with recurrence. The number of treatments at the department of physical therapy was significantly higher in the group with recurrence. If mouth opening does not increase during physical therapy or reduces despite treatment, one should take in to account a recurrence of the tumour and referral back to the oral and maxillofacial surgeon is warranted.

Conclusion

The results of this retrospective study indicate that mouth opening increases significantly after exercise therapy in patients with trismus. The increase in mouth opening is significantly larger in patients with trismus not related to cancer as compared to patients with trismus related to head and neck cancer.

Conflict of interest

None.

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